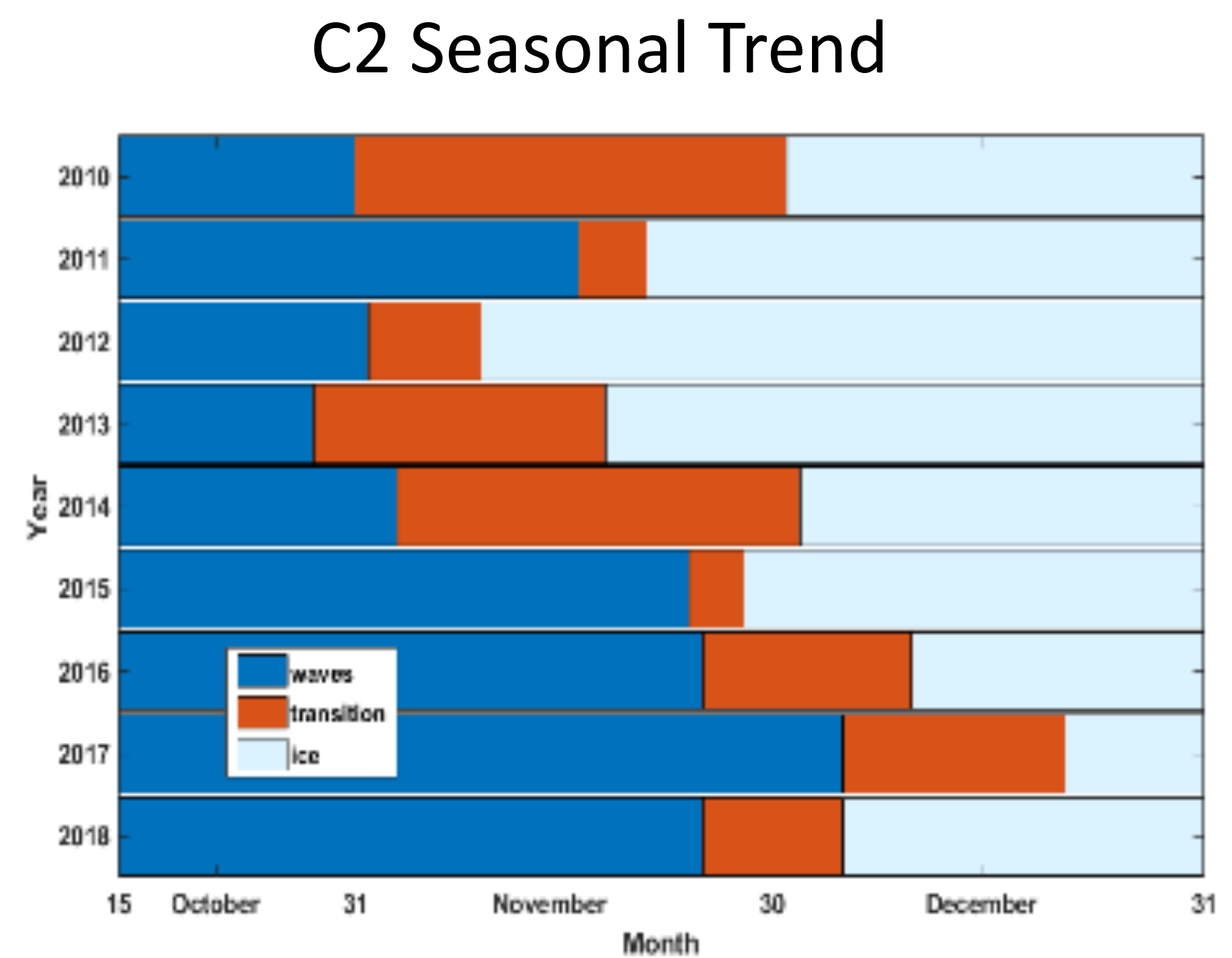


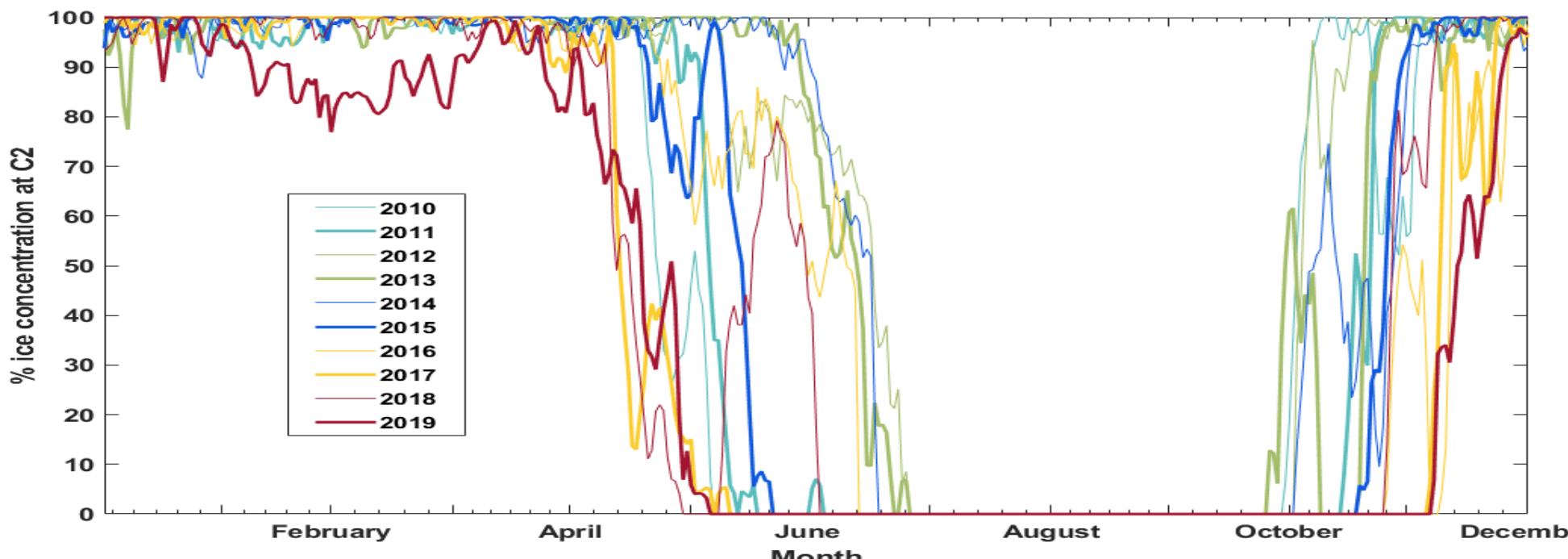
Changing Seasons in the Chukchi Sea: Ice, Keels, Walrus near Icy Cape, Alaska

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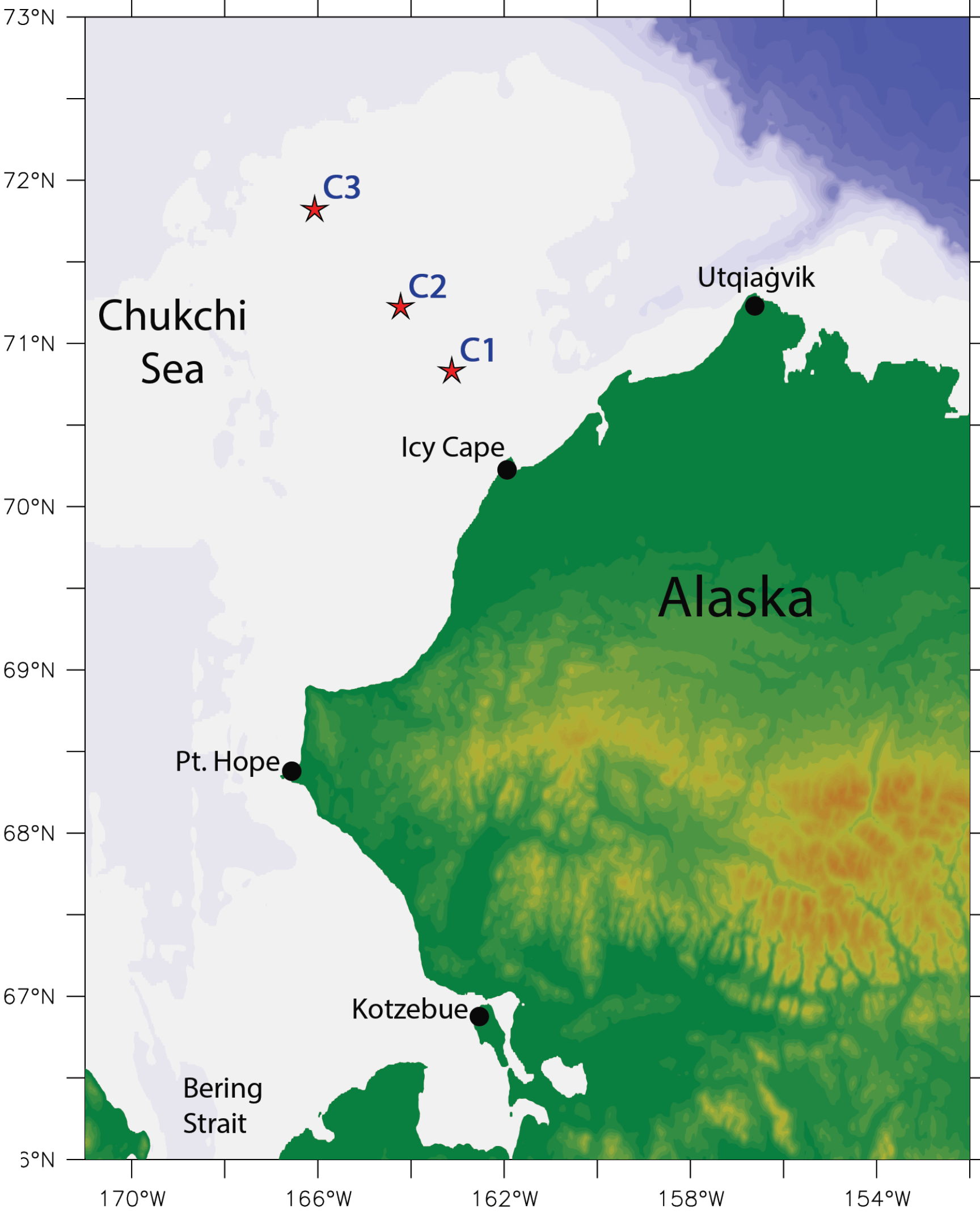
1 University of Washington, Joint Institute for the Study of the Ocean and Atmosphere
2 NOAA, PMEL, Ecosystems & Fisheries-Oceanography Coordinated Investigations
3 NOAA, AFSC, Cetacean Assessment and Ecology Program



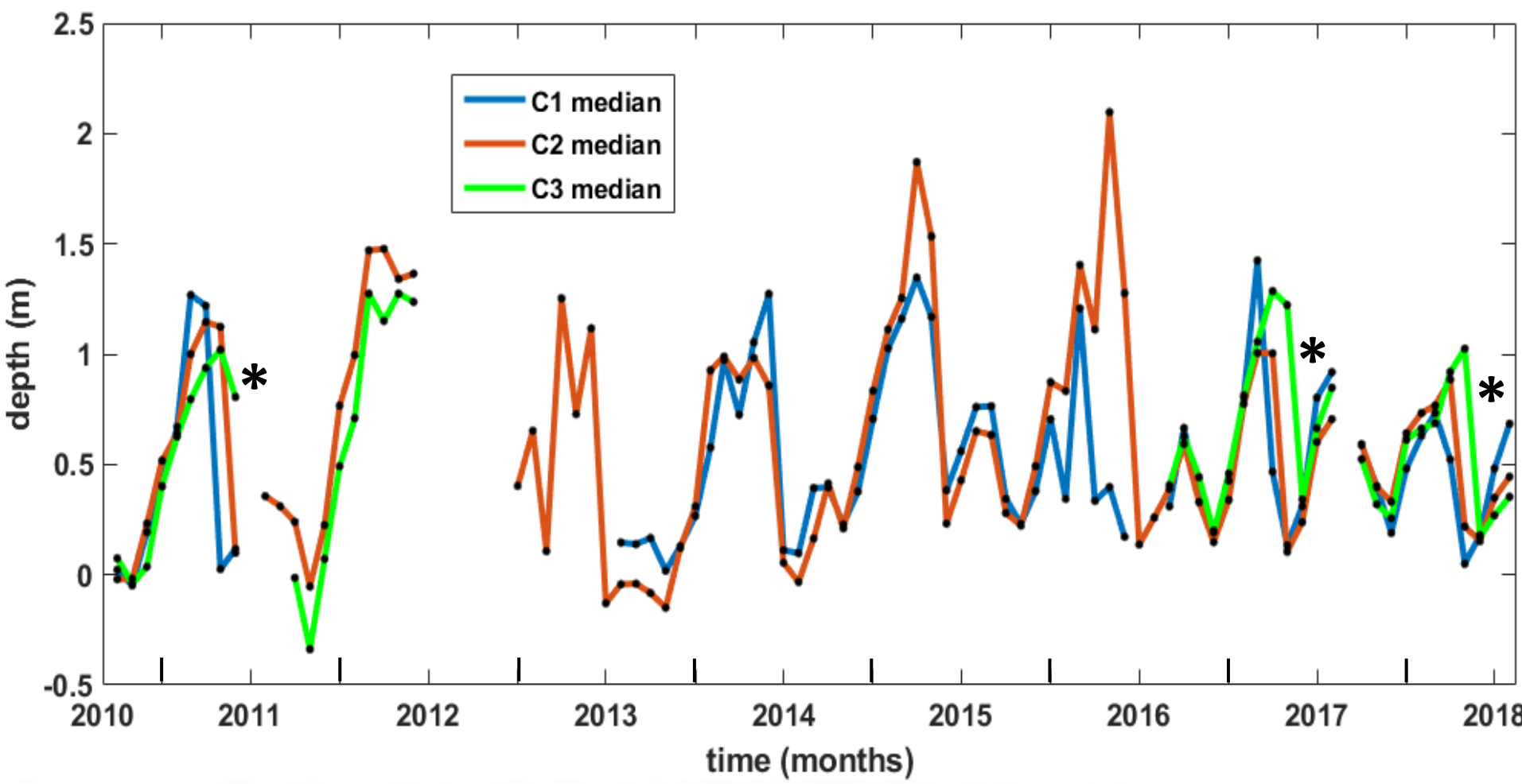
Fall waves-ice transition at C2, 2010-18:
Ice transition (red) from **waves** (dk.blue) to **ice cover** (lt.blue) is **trending towards later in the Fall**.



SSM/I Percent Ice Concentration at C2, 2010-2019 shows spring and fall variations in freeze-up and melt, and a trend toward **earlier Spring and later Fall transitions**.



C1, C2, C3, 2010-2018
monthly median ice draft



Note **higher ice volumes at C2** (red), and **pattern of melt (*)** that starts near-shore at C1 followed further offshore by C2 then C3.

Overview

The Chukchi Sea has seen dramatic warming and sea ice changes in recent years. One-second ice draft data were collected from upward-looking sonar instruments in the northern Chukchi Sea near 71° N at stations C1, C2, and C3 northwest of Icy Cape, Alaska from fall, 2010 to the present. Stations were chosen based on proximity to the Alaskan Coastal Current, Barrow Canyon and Hanna Shoal.

Winter seasons vary in length and are mostly ice covered, with periods of leads, polynya, frazil ice and waves. Spring and Fall transitions show ice-wave variability which is more orderly in Fall and more chaotic in Spring. Pack ice remnants pass through in June into July, and the Chukchi Sea has open water Summer into Fall. In this data record, seasonal ice arrival and melt show shifts over time. Deep ice keel observations occur March to July and can be >25m deep in ~45-m water. We investigate seasonal ice, warming trends, walrus presence, and shifts in seasonal transitions.

Findings & Considerations

- In comparing ice at stations C1, C2, and limited data at C3, ice depth at C2 is similar to or greater than the other stations.
- Fall Transition from open water to sea-ice cover, shown at C2, is occurring later in the year. This trend is supported by SSM/I ice concentration data at C2.
- Walrus have moved north from the Bering to the Chukchi Sea in winter. Sound observations typically increase as ice disappears in the Spring. A few observations indicate walrus presence at C3 following ice keel events prior to Spring melt.
- Deep ice keels occur March-to-June. **Maximum observed keel depth in the C2 record was 28.59 m (2016)**, and keels >20m numbered 7 in 2011, 15 in 2012, 21 in 2015, 2 in 2018 and 8 in 2019.

	C1	C2	C3	#deployed(fail)
2010-11	X	X	X	3
2011-12	X	X	X	3 (1)
2012-13		X		1
2013-14	X	X		2
2014-15	X	X		2
2015-16	X	X		2
2016-17	X	X	X	3
2017-18	X	X	X	3
2018-19	X	X	X	3

Ice profiler deployments, 2010-2018
Red 'X' = NO DATA



POSTER



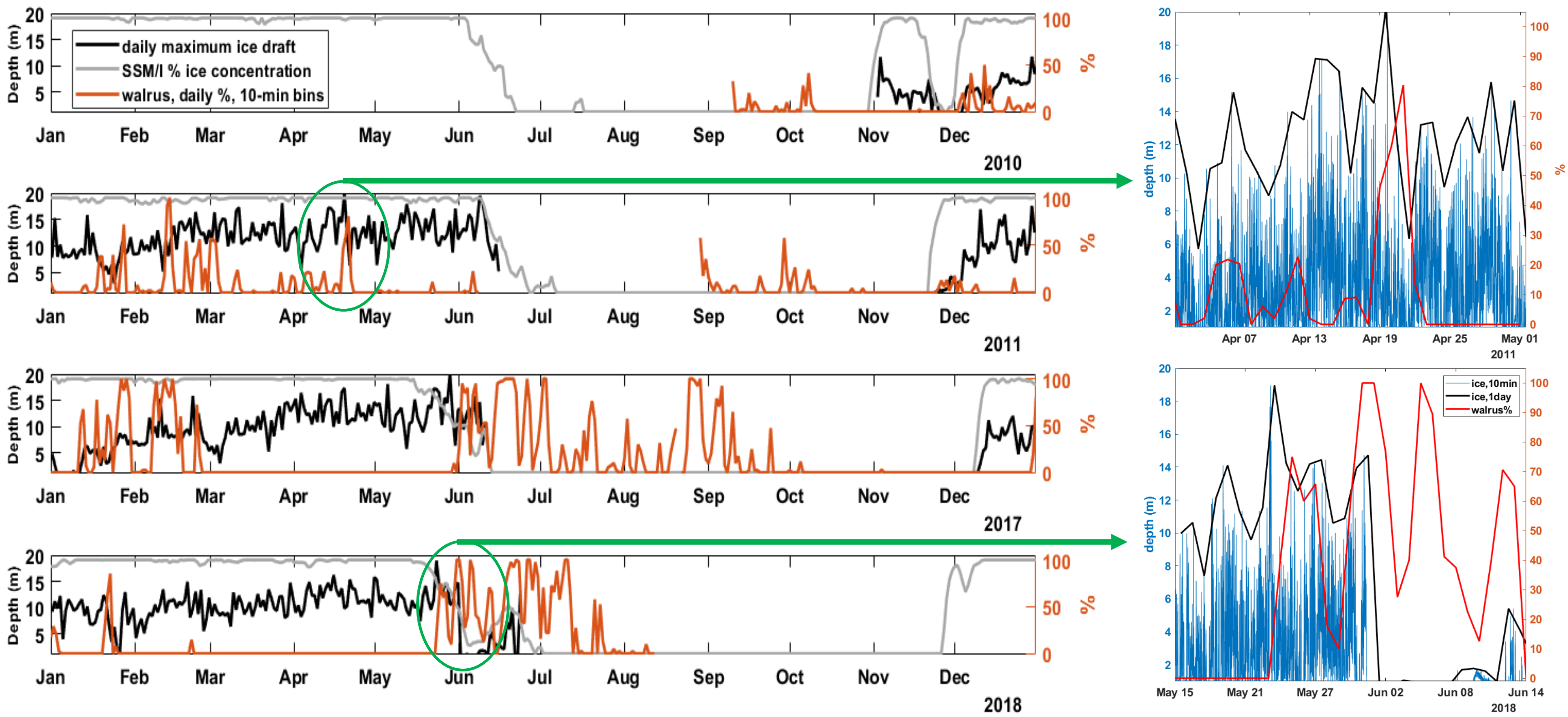
DATA INFO

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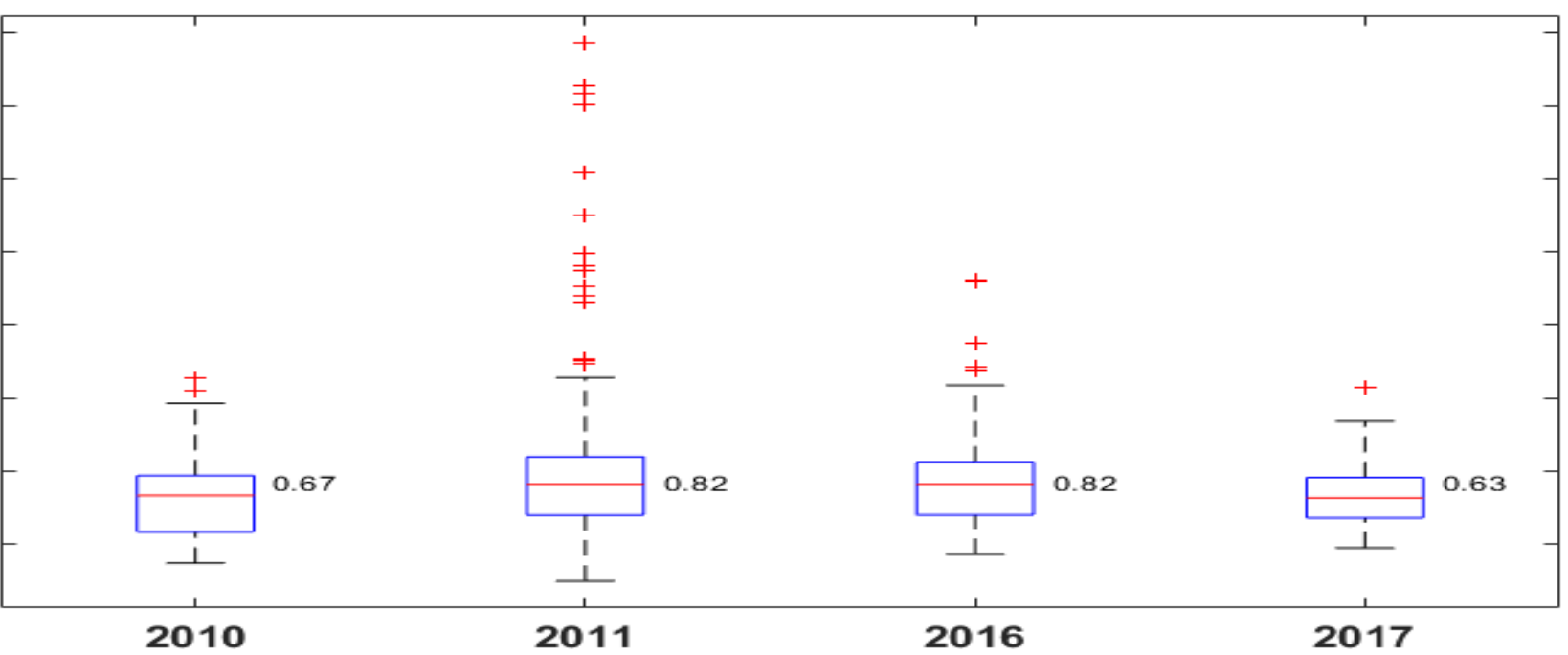


Walrus, Chukchi Sea, 2016. Photo: Nick Hajdukovich. NMML permit # 14245.

C3 Walrus & Ice



Daily ice draft, SSM/I % ice concentration (gray; MODIS True-Color), and **walrus sounds** (red; daily percentage of sounds heard in 10-minute bins) in 2010, 2011, 2017, and 2018.



C3 ice-draft box-and-whisker plots, 2010-11, 2011-12, 2016-17 and 2017-18 showing quartiles, statistics and outliers (+).